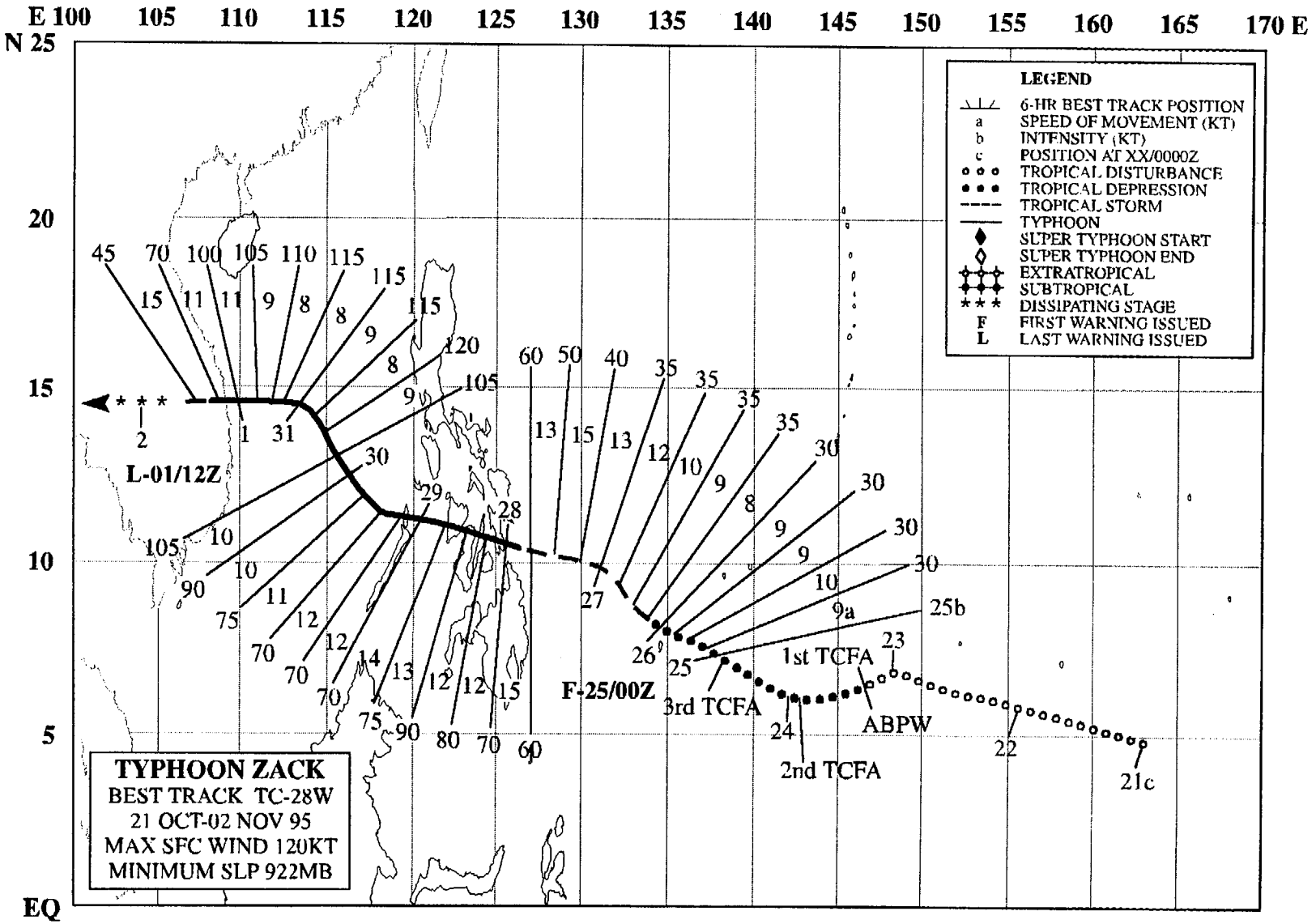
E 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170 E
N 25
20
15
10
5
EQ
LEGEND
6-HR BEST TRACK POSITION
a SPEED OF MOVEMENT (KT)
b INTENSITY (KT)
c POSITION AT XX/0000Z
TROPICAL DISTURBANCE
TROPICAL DEPRESSION
TROPICAL STORM
TYPHOON
SUPER TYPHOON START
SUPER TYPHOON END
EXTRATROPICAL
SUBTROPICAL
DISSIPATING STAGE
F FIRST WARNING ISSUED
L LAST WARNING ISSUED
L-01/12Z
F-25/00Z
1st TCFA
2nd TCFA
3rd TCFA
ABPW
TYPHOON ZACK
BEST TRACK TC-28W
21 OCT-02 NOV 95
MAX SFC WIND 120KT
MINIMUM SLP 922MB

TYPHOON ZACK (28W)

I. HIGHLIGHTS

Originating from a tropical disturbance in the eastern Caroline Islands, Zack did not significantly intensify for nearly six days. As was the case with Sibyl (20W), Zack intensified as it crossed the Visayan islands. But, unlike Sibyl (which weakened over the South China Sea after crossing the Philippines), Zack intensified significantly, peaking at 120 kt (62 m/sec). Zack became one of that region's most intense tropical cyclones (see Ryan's summary for a discussion of very intense tropical cyclones in the South China Sea). Typhoon Zack, along with Super Typhoon Angela (29W) and Tropical Storm Brian (30W), comprised one of only three occasions during 1995 that the JTWC was simultaneously warning on three tropical cyclones in the western North Pacific. Zack made landfall in Vietnam with 100 kt (51 m/sec) maximum sustained winds. It left a path of death and destruction in both the Philippines and Vietnam.

II. TRACK AND INTENSITY

The tropical disturbance that became Zack was first detected on 21 October along the axis of the near-equatorial trough near Kosrae, and was first mentioned on the 230600Z Significant Tropical Weather Advisory. This poorly defined tropical disturbance appeared to have multiple wind circulation centers creating a difficult diagnostic situation. The circulation that became Zack was properly identified at 221200Z when amounts of deep convection increased and became focused around a single low-level circulation center. The tropical disturbance that became Zack, like so many others in 1995, was slow to develop. This slow rate of development contributed to the issuance of three Tropical Cyclone Formation Alerts: the first at 230600Z October, the second at 232030Z, and the third at 242030Z. The latter was superseded when the JTWC issued the first warning on Tropical Depression 28W, valid at 250000Z. The system was upgraded to Tropical Storm Zack 30 hours later on the warning valid at 260600Z.

Zack was difficult to track during the early stages of its development. On 25 October, position estimates of Zack's (then Tropical Depression 28W) low-level circulation center made from satellite imagery (Figure 3-28-1) incorrectly indicated that Zack was moving on a northwest track, vice the west-northwest track of the actual system that is shown in the final best track. As a result, positioning errors were as large as 140 nm (260 km) with respect to the final best track. In retrospect, the Japanese research ship, Tokai Maru (call sign: JBOA), passed just to the west of the low-level circulation center at 250600Z where it recorded a minimum sea-level pressure of 1002 mb. It wasn't until the first visible satellite imagery on the morning of 26 October that the satellite fixes began to track the low-level circulation center that was consistent with synoptic data (e.g., the surface and upper-air data from Koror). Forecasts during the period were heavily weighted toward climatology, and the tropical cyclone was forecast to move toward the central Philippines.

On the afternoon of 27 October, Zack began to intensify at a rate of 10 kt (5 m/sec) every 6 hours as it approached the Visayan Islands of the Philippines. Based upon satellite intensity estimates, Zack was upgraded to a typhoon on the warning valid at 280000Z. At 280200Z, Zack struck Leyte with sustained winds of 70 kt (36 m/sec). The Island capital of Tacloban (WMO 98550) recorded a peak gust of 81 kt (42 m/sec) and the Guian radar site on the island of Samar (WMO 98558) recorded a 1-minute sustained wind of 62 kt (32 m/sec) and a peak gust of 68 kt (35 m/sec). Zack continued to intensify as it crossed the Visayan Islands, reaching a peak intensity of 90 kt (46 m/sec) before striking the large mountainous

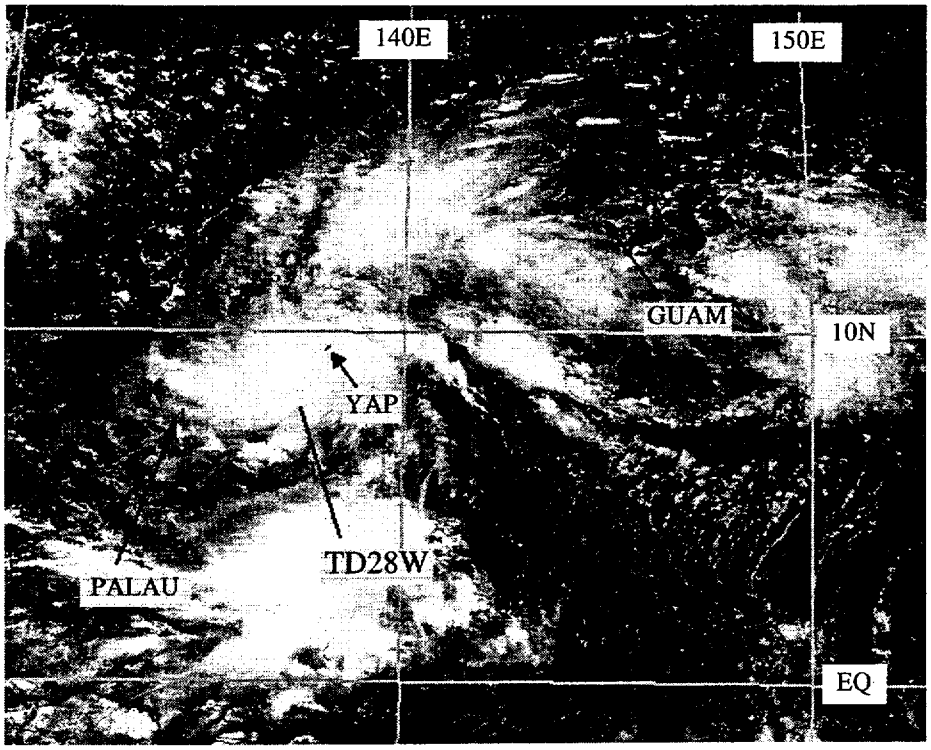

Figure 3-28-1 Tropical Depression 28W is located about 175 nm (325 km) east of Palau. The obvious knot of convection west of Yap was not co-located with the primary low-level circulation center. (250424Z October visible GMS imagery).

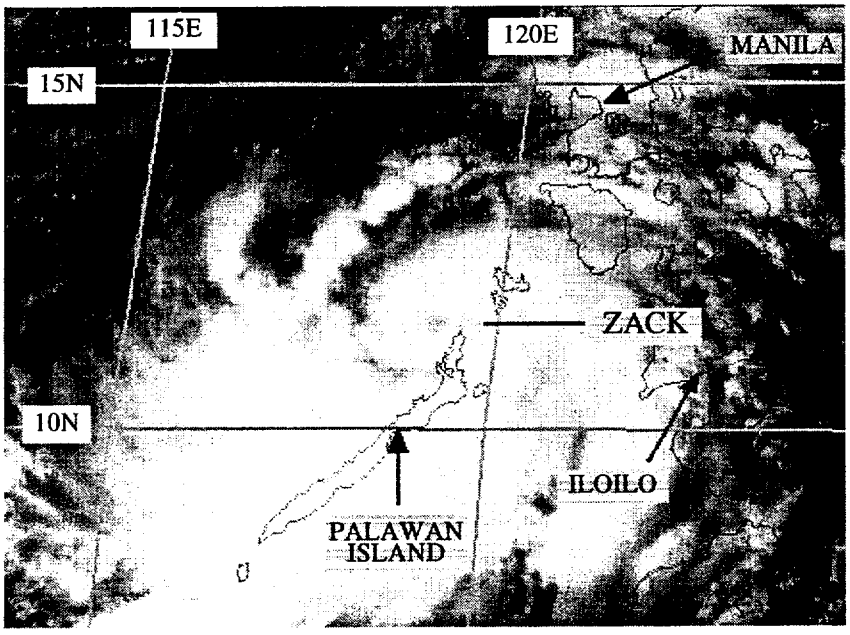

Figure 3-28-2 Typhoon Zack, at an intensity of 70 kt (36 m/sec) enters the South China Sea after passing by the northwest tip of Palawan Island (290531Z October visible GMS imagery).

island of Panay, after which the typhoon weakened (Figure 3-28-2). Both Cuyo Island (WMO 98630) and Iloilo (WMO 98637) measured sustained winds of 62 kt (32 m/sec) as Zack was crossing Panay. Possible mechanisms for intensification while crossing through an archipelago of high islands are outlined in the discussion section of Typhoon Sibyl's (20W) summary — Sibyl (20W) also intensified as it followed a path similar to Zack's through the central Philippines.

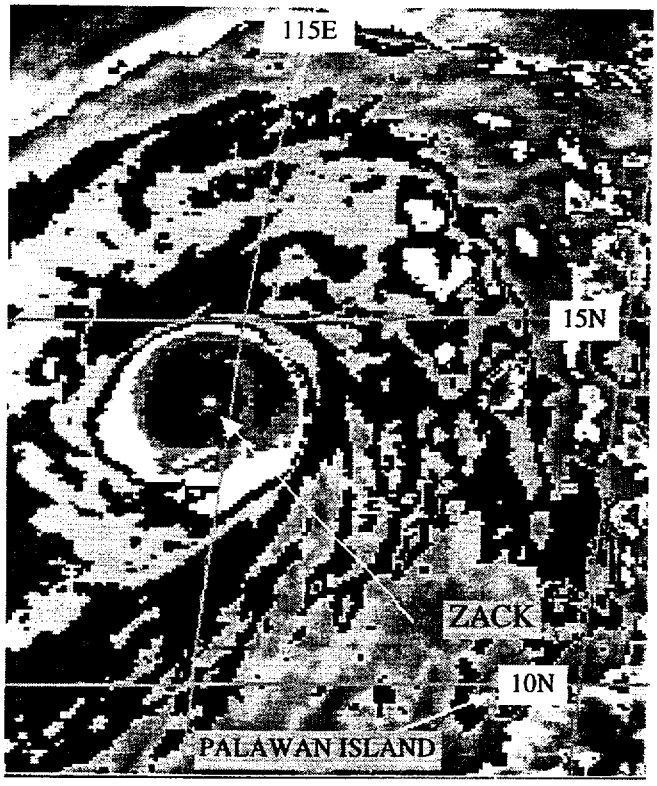

Figure 3-28-3 Typhoon Zack at peak intensity (301231Z October enhanced infrared GMS imagery).

After entering the South China Sea, Zack began to re-intensify. From 291800Z to 301200Z (a period of only 18 hours), Zack intensified 45 kt (23 m/sec) to its peak intensity of 120 kt (62 m/sec) (Figure 3-28-3). The associated rate of decrease of the estimated minimum sea-level pressure of 2.5 mb/hour meets the criterion for explosive deepening (see the discussion section). After peaking, Zack slowly weakened over water as it headed westward toward Vietnam. Zack made landfall in Vietnam at 010300Z November, about 70 nm (130 km) south of Da Nang. The final warning was issued, valid at 011200Z November, as the system entered the highlands of Laos. Complete dissipation occurred 18 hours later over Thailand.

III. DISCUSSION

a. *Intensification while passing over the central Philippines*

Zack, like Sibyl (20W), intensified while tracking across the central Philippines. For a discussion of the possible mechanisms for intensification while crossing through an archipelago of high islands, the reader is referred to the discussion section of Typhoon Sibyl's (20W) summary.

b. *Explosive deepening in the South China Sea*

Zack intensified 45 kt (23 m/sec) over an 18-hour span while over water in the South China Sea. This corresponds to a decrease of minimum sea-level pressure of 2.5 mb/hour which meets the criterion for explosive deepening as described by Dunnavan (1981). Zack reached a peak intensity of 120 kt (62 m/sec) at 301200Z (Figure 3-28-3). It is interesting to note that Zack appears to be totally isolated from its environment as the phase of explosive deepening began (Figure 3-28-4). In a study of the relationship between the cloud pattern and the intensification rate of tropical cyclones, Spratt (1990) found no significant differences in the average intensification rates of tropical cyclones whose cloud patterns resembled a "9", a "6", a two-tailed pattern (resembling the tropical cyclone symbol), or those (like Zack) that were circular.

IV. IMPACT

Zack caused considerable death, destruction, and agricultural losses in the Visayan Islands of the Philippines. Hardest hit of the Visayan Islands were Panay and Negros Occidental. There were over 110 deaths reported, of which 72 occurred in Negros Occidental, 18 in Cebu, and 20 in Iloilo. Flooded rivers and capsized boats claimed most of the victims. More than 30,000 homes were reported destroyed or damaged and preliminary estimates of agricultural losses amounted to US$2 million, primarily sugar cane. Bacolod, a city of 400,000, was without power for several days.

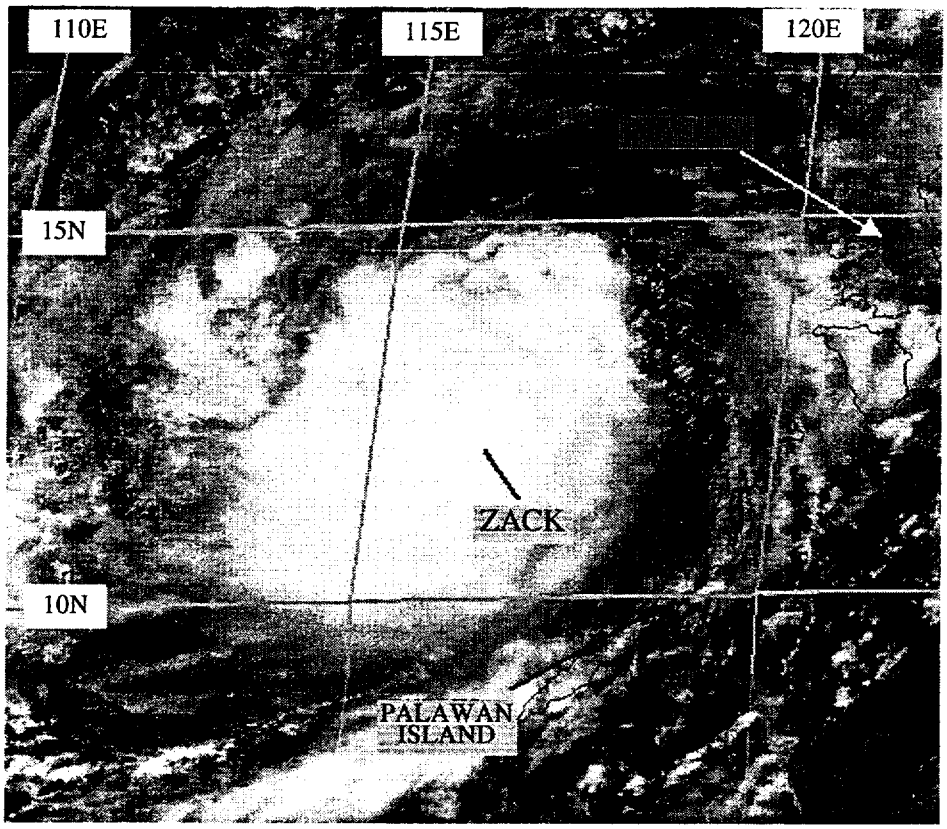

Figure 3-28-4 Zack is undergoing explosive deepening at the time of this picture (300031Z October visible GMS imagery). Note that the system appears to be isolated from its environment.